REMARKS

Description of the Invention

Applicant's invention relates to a method for preparing membrane electrode assemblies (MEAs), and in particular to a method of manufacturing a proton-conducting cation-exchange electrolyte membrane for use in a membrane electrode assembly (MEA), in which atmospheric pressure plasma deposition is used to deposit catalysts such as platinum onto a polymer substrate, or a substrate including carbon cloth or carbon particles. The invention has three principal characteristics:

1) The noble metal catalyst is deposited on the membrane by discharge enhanced chemical vapor deposition (DECVD); and

2) The DECVD is carried out at atmospheric pressure, without adding noble gases to the single mixed randomized DECVD carrier gas/reactant stream which is the only gas stream in the process where the single mixed randomized gas stream of reactants in a carrier gas is the only gas stream which passes directly between said 2 or more electrodes,

3) The reactants included in a carrier gas pass directly between 2 or more electrodes supplied by a single power source.

Claims

Claims 1, 3-9, and 11-16 are pending, and stand rejected.

Claim 1 has been amended to cite a single power supply. This amendment is supported y Figures 1A and 1B, as well as paragraph [0048], line 8.

35 U.S.C. §103

Hammerschmidt in view of Fukuda and JP 10-275698

Claims 1, 3, 5-6, and 11-14, stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hammerschmidt (US 6,010798) in view of Fukuda (US 6,849,306), Fukuda US 2003/02032136, and JP 10-275698. These references fail to create a *prima facie* case of obviousness over Applicant's claims, as amended.

The Hammerschmidt reference describes a fuel cell having a proton conducting membrane on which a catalyst material and a collector are arranged. The catalyst is applied using a plasma-chemical process. (Col 3, lines 42 and 43) The Hammerschmidt reference fails to teach or suggest Applicant's claimed discharge enhanced chemical vapor deposition process carried out at atmospheric pressure without adding a noble gas and having a single mixed randomized gas stream of reactants in a carrier gas which is the only gas stream passing directly between 2 or more electrodes, and therefore fails to present a prima *facie case* of obviousness.

The Hammerschmidt reference describes deposition examples "low-pressure plasma between 10^{-4} and 10 mbar", and as an alternative "sputtering methods". (Col 3, lines 40 – 55). Both of these methods are very different from the atmospheric pressure plasma deposition method claimed by Applicant, and the differences have been clearly discussed in the many responses to rejections filed by Applicant in this application. One of ordinary skill in the art would not be motivated by a teaching of a membrane, and disclosure only of methods for forming that membrane that do not contain all of Applicants claimed elements and limitations, to practice Applicant's claims.

The Examiner asserts that the Hammerschmidt reference is not meant to be limited only to the described techniques. Applicant agrees. However, the silence of Hammerscmidt on any atmospheric discharged enhanced chemical vapor deposition is not a teaching or suggestion of such a method. Silence fails to teach or suggest anything, while the non-silent teachings of Hammerschmidt do teach away from Applicant's claims. Applicant does not believe one of ordinary skill in the art would arrive at Applicant's claims from the Hammerschmidt silence and teaching away.

The Fukuda '306 reference teaches an apparatus design that specifically attempts to minimize any turbulent flow and any mixing of the gases. The Fukuda '306 reference states: "the apparatus is constructed so that the reactive gas is not directly in contact with the discharge surface of the first electrode or the second electrode" (Col 3, lines 28-31). In column 15, lines 29-45 the Fukuda reference describes the workings diagramed in Figure 2. "The voltage application electrode is provided so that the electrode is surrounded with the gas paths, whereby turbulent flow is difficult to occur in the discharging space, the inert gas contacts the voltage application electrode 2, and the

reactive gas contacts the surface of substrate 1. The above structure of the electrode section is such that the voltage application electrode 2 does not directly contact the reactive gas for forming a layer…". The goal of Fukuda is to minimize turbulent flow. The Examiner asserts that some mixing at the interface will occur. However, the presence of any interface contradicts Applicant's claim limitation of a randomized gas stream. The Fukuda method does not teach or suggest Applicant's randomized gas stream, and instead teaches away fro m a randomized stream by specific designs to minimize mixing.

The Fukuda '136 reference uses a mixed gas stream using nitrogen as the carrier – but requires two (2) power supplies to create two different frequencies in order to make the apparatus perform. Applicant's claims, as amended, require only a single (1) power source. The Fukuda teaching that at least 2 power sources are needed in a mixed gas system teaches away from Applicant's claimed single power source. Therefore Fukuda '136 teaches 2 power sources are required for a mixed gas stream, while Fukuda '306 teaches that for a single power source the gases should not be mixed. Both references not only teach away from Applicant's claims, they also support the fact of Applicant's surprising and unexpected invention.

JP 10-275698 is cited as a secondary reference to show that atmospheric plasma can be formed without a rare gas. The JP 10-275698 solution is to begin with a mixture of oxygen and helium, then turn off the helium and continue plasma generation to perform ashing or etching. Thus the JP 10-275698 is a method requiring a noble gas (helium) for the process to occur – while Applicant's specifically claim NO noble gas is added in the method. Thus the JP 10-275698 reference both fails to teach all of Applicant's claim limitations, and also teaches away by requiring an element (noble gas) which cannot be present in Applicant's claimed method.

Each of the cited references alone or together fails to teach or suggest all of Applicant's claim limitations, while each reference teaches away from Applicant's claims. A combination of the Hammerschmidt process silent of atmospheric chemical discharge, with the Fukuda '306 reference requiring separate (and certainly not random) gas streams, with the Fukuda '136 reference requiring 2 power sources and the JP 10-275698 reference requiring some use of a noble gas cannot lead one of ordinary skill in

the art to Applicant's claimed method of atmospheric chemical discharge deposition, using a randomized mixed gas stream, a single power source and having no noble gas used in the method.

Hammerschmidt in view Fukuda, Fukuda, JP 10-275698 and Others (generally):

As shown above, the Hammerschmidt reference in view of Fukuda '306, Fukuda '136, and JP 10-275698 fails to teach or suggest all of Applicant's claim limitations, in particular: A catalyst deposited on a membrane by discharge enhanced chemical vapor deposition (DECVD); at atmospheric pressure, without adding noble gases to the single mixed DECVD carrier gas/reactant stream, where the reactants included in a carrier gas pass directly between 2 or more electrodes having a single power source. The Examiner then cited additional references, none of which, taken with the cited references, cite all of Applicant's claim limitations (as amended). Therefore, no *prima facia* case of obviousness is presented.

Hammerschmidt in view Fukuda, JP 10-275698 and Schutze

Claim 4 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Hammerschmidt (US 6,010798) in view of Fukuda (US 6,849,306), Fukuda US 2003/02032136, and JP 10-275698, further in view of Schutze. The Schutze reference teaches a plasma jet using flowing helium. Applicant's amended claims cite a method without adding noble gases to the DECVD carrier gas. The Schutze reference not only fails to teach or suggest Applicant's claim limitation of no added noble gas, but teaches away from Applicant's claims by requiring a noble gas. The Schutze reference fails to correct the deficiencies of the other cited references, fails to teach or suggest Applicant's claim limitations, and teaches away from Applicant's claims.

Further in view of Yasumoto

Claim 7 stands rejected further in view of Yasumoto (US 2003/0096154). The Yasumoto is a secondary reference cited by the Examiner to teach the spraying of the catalyst onto the surface of the polymer electrode membrane. Applicant's do not claim a

method in which a catalyst is sprayed onto a polymer electrode membrane, but rather a discharge enhanced chemical vapor deposition method. Thus the Yasumoto reference fails to teach Applicant's claims.

Further in view of Nanaumi

Claims 8-9 stand rejected under 35 U.S.C. 103(a) as being unpatebtable further in view of Nanaumi (US 2004/0180250).

The Nanaumi reference is cited to cite polymer electrolyte membrane structures. However the Nanaumi reference fails to teach or suggest Applicant's many claim limitations, and fails to correct the many deficiencies of the other references cited.

Further in view of Kamo

Claims 14 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336), and further in view of Kamo (US 2003/0059659). The Kamo reference is a secondary reference cited to show the use of a platinum alloy in the anode side of an electrolyte membrane. While the Kamo reference discloses a platinum/ruthenium alloy for a fuel cell electrode, the platinum/ruthenium alloy is supported on a carbon powder, rather than directly on a membrane as claimed by Applicant. In Example 2, the platinum/ruthenium alloy is screen printed using a slurry. One in the art would not be motivated by this method alone – or in combination with the other cited reference to practice all of the limitations in Applicant's amended claims.

Further in view of Haug

Claim 16 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Dearnaley (US Patent Number 6,159,533) in view of Schutze in view of Fornsel (WO 01/32949, US 6,800,336), and further in view of Haug. The Haug reference is a secondary reference cited to show the deposition of multiple catalyst layers. The Haug reference demonstrates the use of a vacuum sputter deposition system for producing a PEM. The disclosure of a multiple layer of catalyst by methods teaching away from

Applicant's claimed method fails to heal the defects of the cited art to present a *prima facie* case of obviousness.

Conclusion

The references cited, either alone or in combination, fail to teach or suggest all of Applicant's claim limitations, and therefore fail to present a *prima facie* case of obviousness over Applicant's amended claims. For the above reasons the present claims 1, 3-9, and 11-16 are believed by the Applicant to be novel and unobvious over the prior art, thus the claims herein should be allowable to the Applicant. Accordingly, reconsideration and allowance are requested.

Respectfully submitted,

/thomas.f.roland/ Date: September 4, 2008

Thomas F. Roland
Reg. No. 42,110
Tel. 215-419-7314

Customer Number 31684